

RECLAMATION

Managing Water in the West

Strategies for Treating Variable Source Waters

Michelle Chapman

Frank Leitz

Singapore International Water Week – 2010



U.S. Department of the Interior
Bureau of Reclamation

The most common process of desalination used today is reverse osmosis (RO).



Yuma
Desalting
Plant in
Yuma,
Arizona

RECLAMATION

The typical desalting plant is designed for constant operation optimized for average water condition.

However, when the amount of water to be treated, or the composition changes widely, one needs to consider global optimization.

RECLAMATION

Examples of Variable Source Waters

- Irrigation return flows – quantity varies with irrigation schedule, composition varies with time and degree of evaporation or absorption.
- Estuarial Rivers with tidal influx that varies over the day, month, and year – increasing with seawater rise.
- Coastal regions with seasonal supplies of storm water, or surface water that rely on seawater during the dry season.
- Groundwater aquifers that are expected to become more saline over time.

Factors Limiting Flexibility

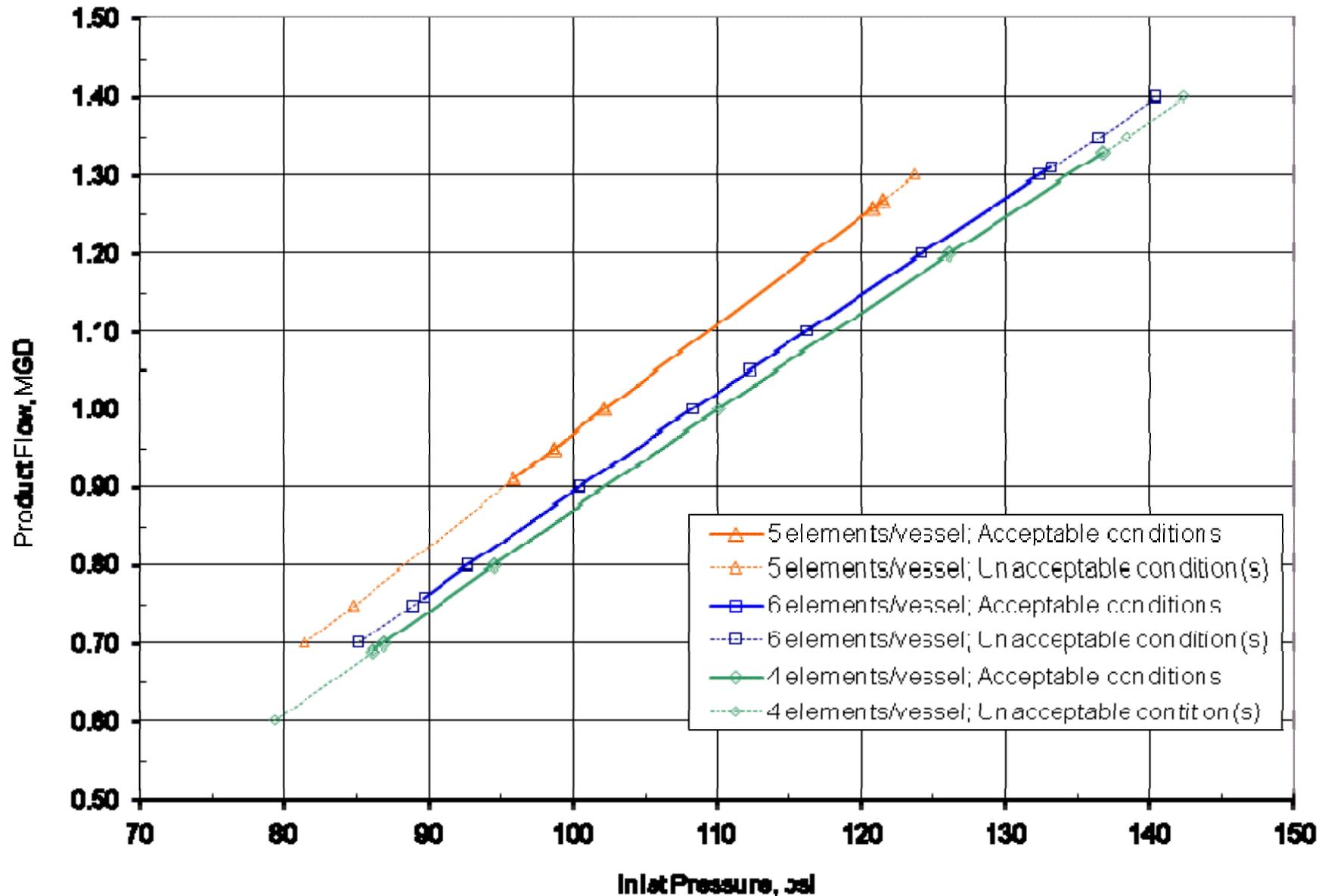
- **Materials**
- **Number of stages, elements per stage**
- **Degree of separation**
- **Energy conservation**
- **Water conservation**

RO Operating Constraints

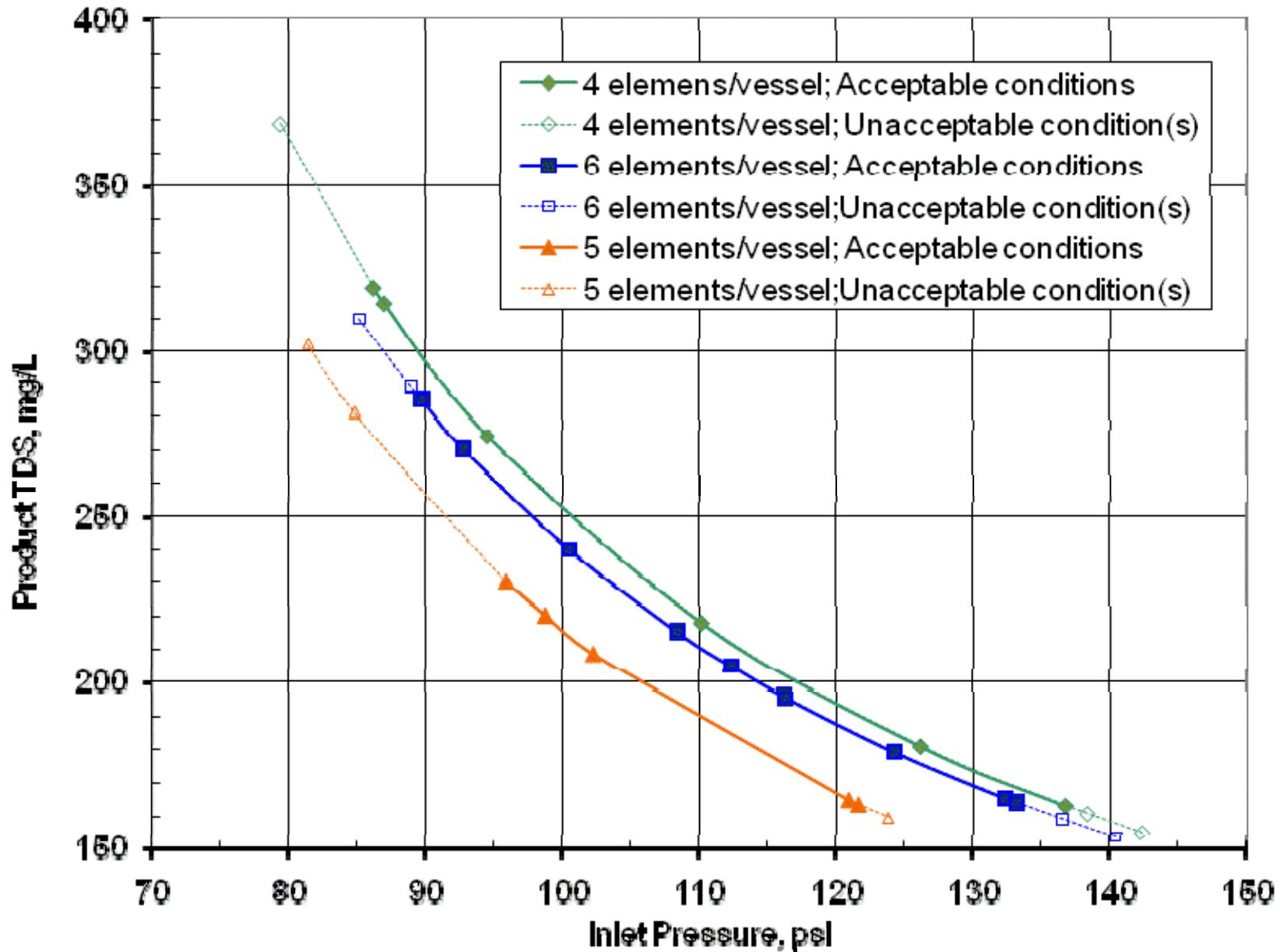
- Maximum feed flow and maximum feed pressure
- Minimum concentrate flow
- Maximum product flow

Configuration	Elements per Vessel	Number of Vessels in Stage 1	Number of Vessels in Stage 2	Number of Vessels in Stage 3
I	6	26	14	–
II	5	32	16	–
III	4	26	20	14

Variation in Capacity



Configuration and Quality



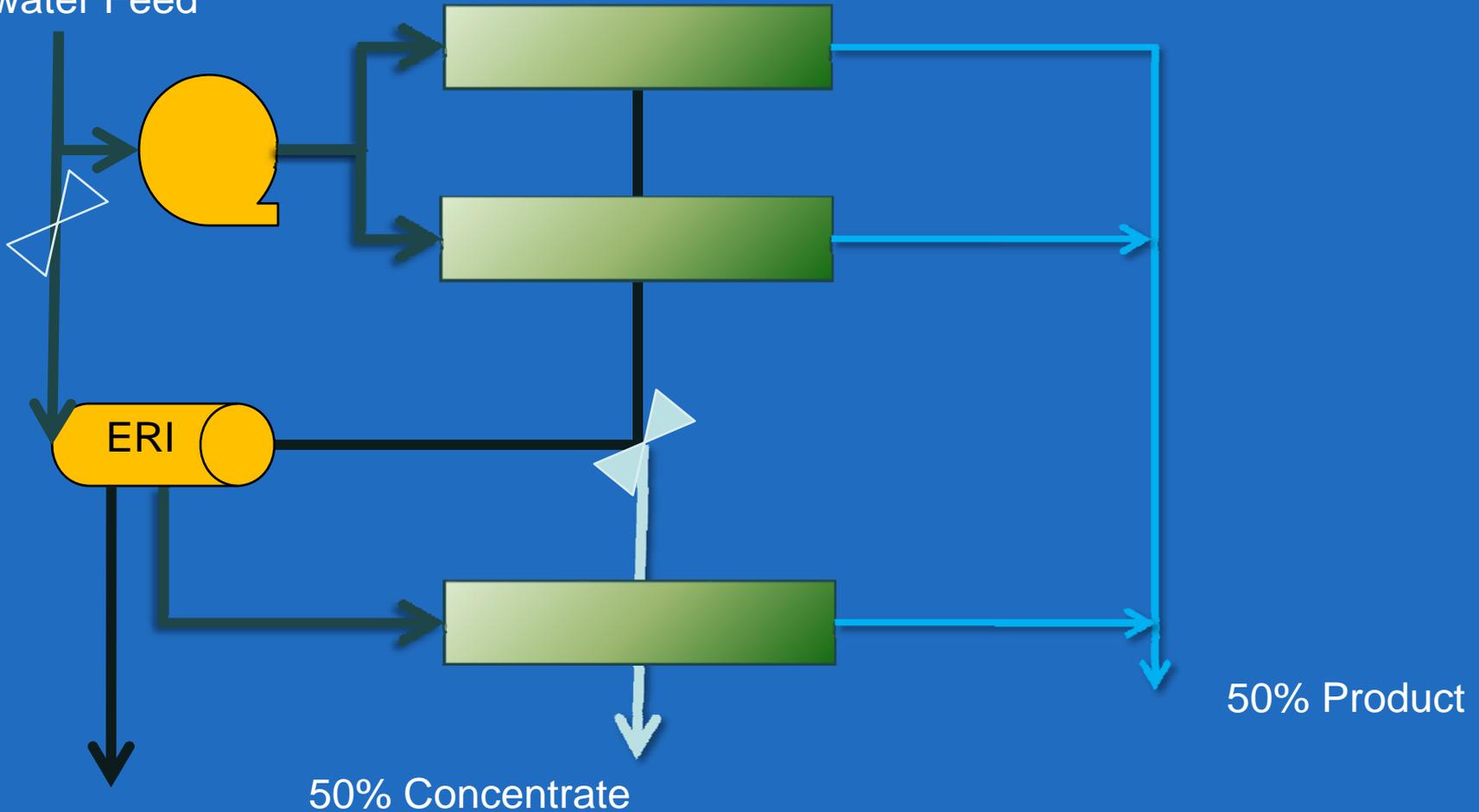
Expeditionary Unit Water Purifier



~375 m³/day
UF-RO
50% Recovery
3.5 kWhr/m³

Sea Water System

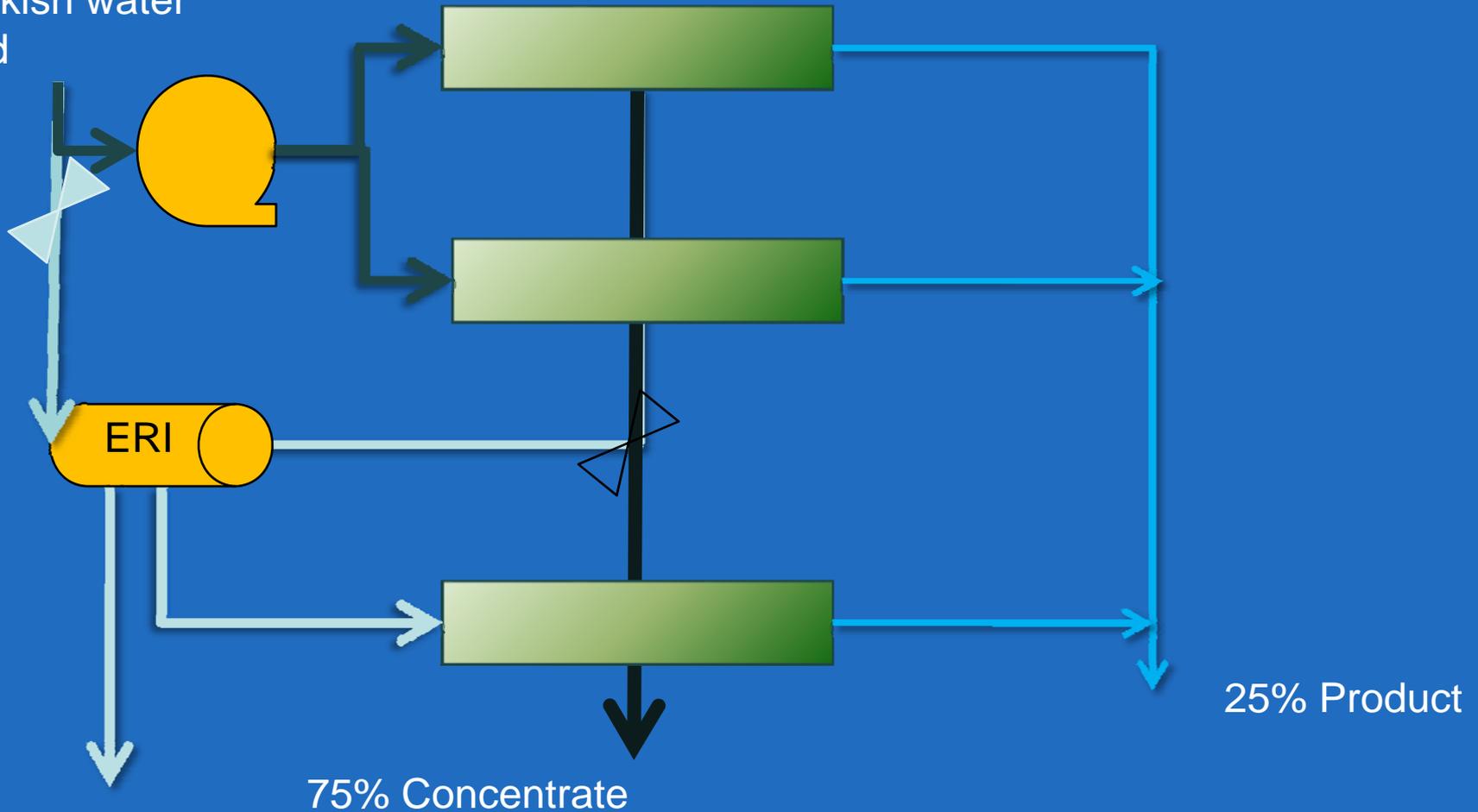
Seawater Feed



RECLAMATION

Sea Water System

Brackish water
Feed



RECLAMATION

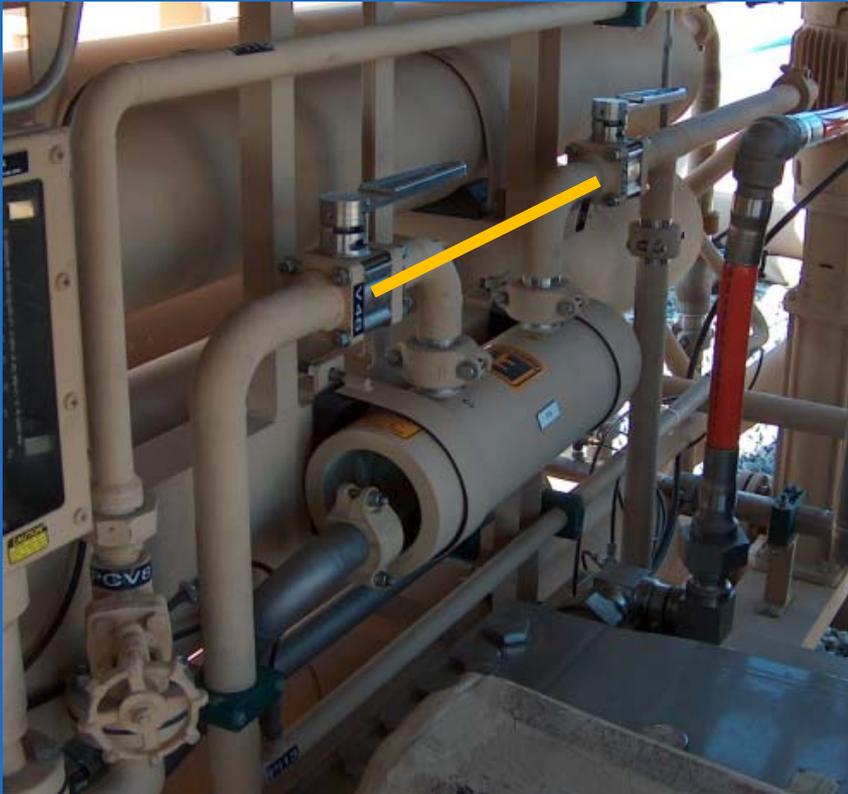
Actual Performance w/ SW & BW

	Feed			Permeate			Concentrate		
	Flow (L/min)	TDS	Pres (Bar)	Flow (L/min)	TDS	Pres (Bar)	Flow (L/min)	TDS	Pres (Bar)
Seawater HP Array	430	32,627 mg/L	65	212	240 mg/L	1.4	218	N/A	62.8
Seawater PX Array	250		63	95		1.4	155		59
Brackish HP Array	408	1720 μ S/cm	20	185	9 μ S/cm	1.4	223	3640 μ S/cm	14
Brackish PX Array	148		14	61		1.5	87		9.6

Simulated Performance w/ 75% Recovery using 2 stages

	Feed			Permeate			Concentrate		
	Flow (L/min)	TDS	Pres (Bar)	Flow (L/min)	TDS	Pres (Bar)	Flow (L/min)	TDS	Pres (Bar)
Brackish HP Array	439	2928 mg/L	29.3	238	6.4 mg/L	1.5	200	6527 mg/L	25.9
Brackish 2 nd Stage	200		25.5	89	16 mg/L	1.5	111	9108 mg/L	22

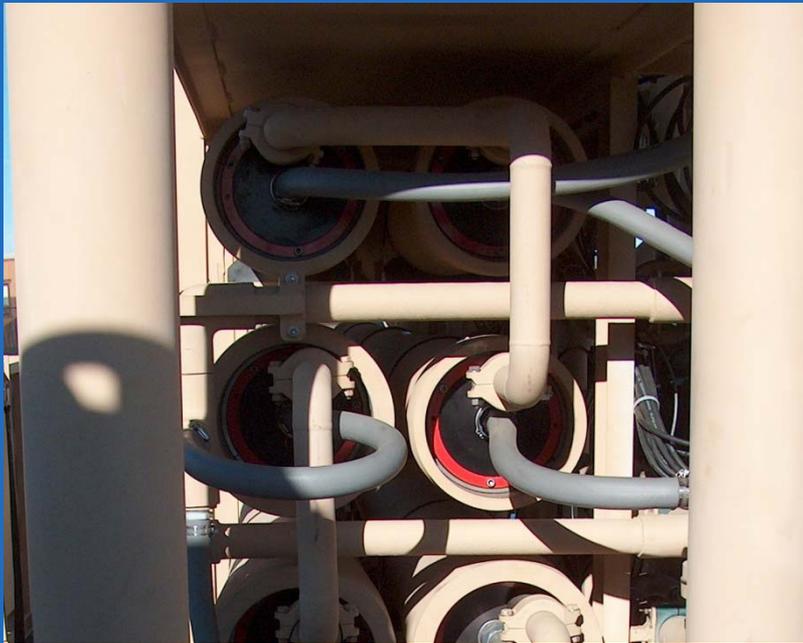
Options for Converting ERI to Flow Through Connection



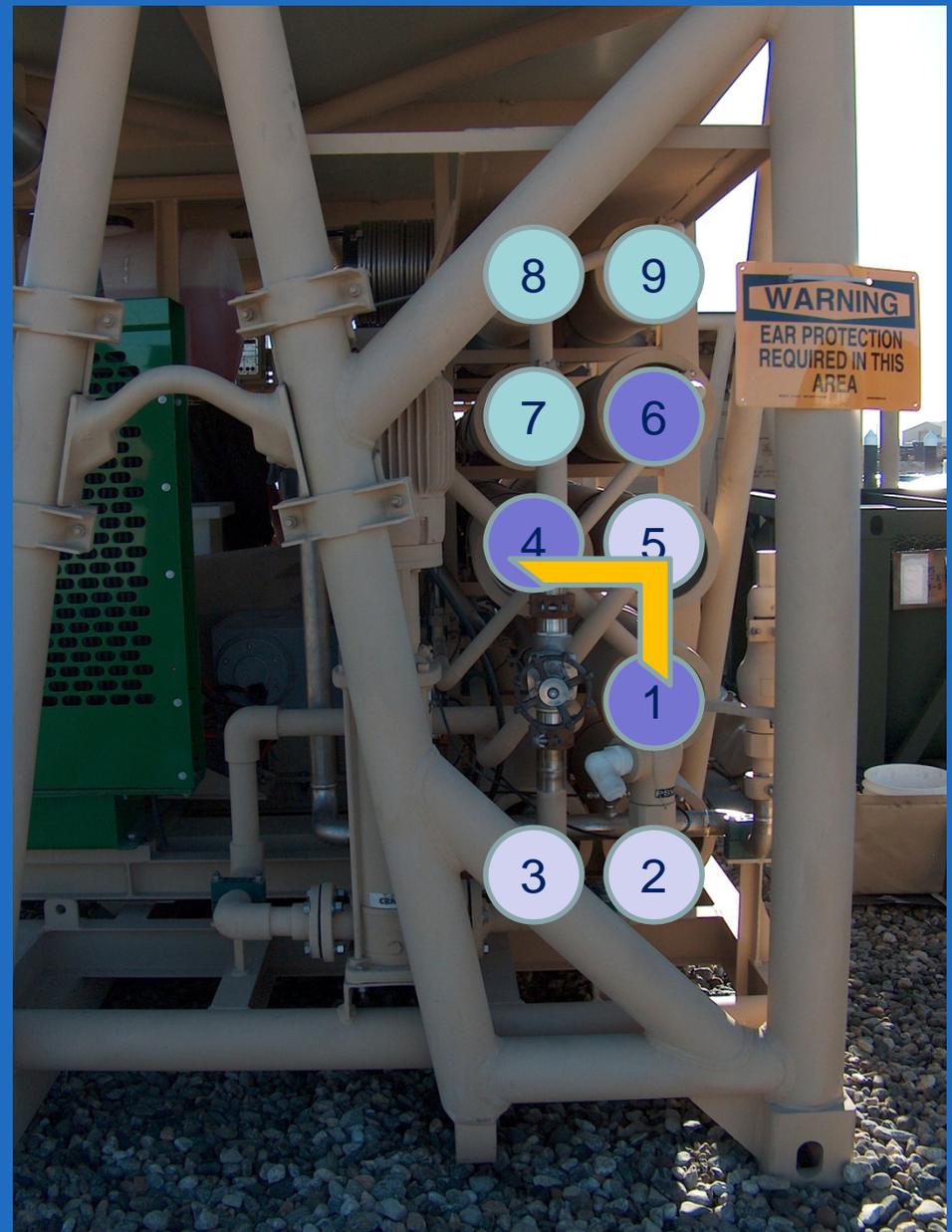
- Replace on off valve with 3-way valve
- Remove 90° connections & install straight pipe.
- Or, re-plumb vessel inlets.

RECLAMATION

Vessel Inlet Manifolds



Use the Second Pass Manifold to connect vessels 1 and 4 to 5.



RECLAMATION

The examples presented above refer to brackish water and seawater. Other combinations of waters could be treated using the same approach.

RECLAMATION

Acknowledgements

- **Jorge Arroyo - Texas Water Development Board**
- **Thomas Michalewicz & Collins Balcomb - Bureau of Reclamation Oklahoma-Texas Area Office**
- **Genoveva Gomez - Southmost Regional Water Authority, Brownsville, Tx**